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## Bicycle Helmet Use by Adults: the Impact of Companionship

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This study was supported in part by grants H28/CCH301618 and R49/CCR302486 from CDC. Delinda Gibson of the Division of Injury Control, CDC, assisted in programming and data editing. Paula Lantz and Kathy Wood, RN, of the Montgomery County Health Department, Alice Novitsky of the National Safe Kids Coalition, and Mary Ellen Bailey, Gregory Biggs, Robert Maslin, and other members of the Baltimore Cycling Club and the Potomac Pedalers Touring Club also helped in the conduct of the study.

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### Synopsis .....

*Most of the nearly 1,000 fatal bicycle-related injuries annually could be prevented if riders used*

*safety helmets. Helmet use by adult bicyclists has received relatively little attention because educational campaigns to promote helmet use generally focus on children.*

*Helmet use by adult and child bicyclists at 120 suburban and rural sites in three Maryland counties was observed on two Saturdays in 1990-91 during an evaluation of the impact of a mandatory helmet law. Concordance or discordance of helmet use within various groups of bicyclists—adults only, adults with children, and children only—was recorded.*

*Helmet use among 2,068 adult bicyclists was 49 percent, 51 percent, and 74 percent in the three counties. In two counties combined, 52 percent (365 of 706) of solo adult bicyclists wore helmets compared with only 5 percent (5 of 94) of solo child bicyclists ( $P < .001$ ). Helmet use or nonuse was concordant among 87 percent of 277 adult-adult pairs, 94 percent of 50 child-child pairs, and 91 percent of 32 adult-child pairs of bicyclists observed. Concordance rates of helmet use or nonuse were similarly high among pairs of adult bicyclists of the same or mixed sexes.*

*These data are consistent with the concept that both adults and children tend to adopt the helmet-wearing behaviors of their companions. Public health efforts focused on adults should encourage helmet use by adult bicyclists both to prevent head injuries and to provide a role model for children.*

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**B**ICYCLING IS AN INCREASINGLY popular recreational activity in the United States. Each year, however, approximately 530 children (ages 0 to 19 years) and 430 adults die, and 443,000 children and 115,000 adults are treated in emergency departments for injuries occurring in bicycle crashes (1). Injuries to the head cause the majority of the bicycle-related deaths and seriously disabling injuries. Thompson demonstrated that safety helmets can prevent 85 percent of bicycle-related head injuries (2).

While the use of helmets by children has been the focus of a number of studies (3-8), few reports provide data on helmet use by adult bicyclists (9-11). Helmet use by adults is important both to prevent head injuries among adult bicyclists and to provide a role model for children who ride bicycles.

In this report, we present helmet use rates for more than 2,000 adult bicyclists observed at suburban and rural sites in three Maryland counties in 1990 and 1991. We also report on concordance and discordance of helmet use within groups of bicy-

clists that included adults only, adults with children, and children only.

The data were collected as part of an evaluation of the impact of a 1990 law in Howard County, MD, that mandated the use of bicycle helmets by children younger than age 16 when riding on county roads and paths. The two adjacent counties selected for comparison with Howard County were Montgomery County, which then had extensive educational helmet promotion efforts in progress (primarily targeting children), and Baltimore County, which had no significant legislative or educational helmet promotion activities in progress. The evaluation was a collaborative effort of the Maryland Department of Health and Mental Hygiene, the Howard, Montgomery, and Baltimore County health departments, the Johns Hopkins University Injury Prevention Center, and the Centers for Disease Control and Prevention of the Public Health Service.

## Methods

The observational methods have been previously described (12). A total of 120 observation sites—40 in each of the three counties—were selected to represent the diversity of socio-economic status and sites where bicycles are commonly ridden in each county. Volunteers from local bicycle clubs served as observers on two occasions—one Saturday in July 1990 before the Howard County law went into effect (baseline) and one Saturday in May 1991 after the law was in effect (followup).

Observers were trained and then sent in pairs to multiple observation sites in a predetermined sequence. In collecting data at a given site, the two observers first had to agree on which bicyclists constituted a group, and then each observer independently recorded the apparent age, sex, ethnicity, and helmet use of each bicyclist. Age group categories were

1. Child—apparent age younger than 13 years,
2. Teenager—ages 13–19, and
3. Adult—ages 20 or older.

For this report, bicyclists recorded as a child by both observers or discrepantly as a child and a teenager by the two observers were considered children. Those recorded as adult by both observers or discrepantly as an adult and a teenager were considered adults. Those recorded as teenagers by both observers or discrepantly as a child and an adult were excluded from all analyses unless other-

wise stated. Groups were categorized as including adults only, children only, or a combination of adults and children. Groups that included teenagers were excluded from group analyses.

The agreement between observers for adult bicyclists was 94 percent for sex, 99 percent for ethnicity, and 97 percent for helmet use. The same proportions for observations of child bicyclists were 97 percent for sex, 96 percent for ethnicity, and 99 percent for helmet use (12). Therefore, analyses of these variables are based on the report of the first of the two observers at each observation site. Data for adults from the baseline and followup observation days were similar and were combined in most analyses. In particular, the baseline and followup observations of adult bicyclists in Howard County could be combined, because the mandatory helmet law did not apply to persons older than age 15 and did not affect substantially helmet use by adults.

Concordance of helmet use was defined as all members of a group of bicyclists wearing helmets, or all group members not wearing helmets. Groups in which some but not all members wore helmets were considered discordant for helmet use. Since some of the analyses on concordance included children, all analyses on concordance excluded data from Howard County where helmet use rates for children significantly increased between the baseline and the followup observation days (12).

Proportional differences in helmet use by sex, ethnicity, age, and observation site were assessed with Pearson's chi-square test. To test for concordance, we assumed that helmet wearing followed a binomial distribution. We used the rate of helmet wearing among comparable solo riders as our best estimate of  $P$  in the binomial expression. This approach assumed independence of helmet use among riders in a group. Observed and expected distributions were also compared with a Pearson chi-square test statistic.

## Results

Of 2,731 bicyclists seen by 98 pairs of observers in the three counties on the two days, 2,068 were defined as adults; 1,899 were recorded as adult by both observers and 169 were discrepantly recorded as adult and teenager. In addition, 448 of the bicyclists were defined as children and 215 were considered in the "all other" category (186 teenagers, 29 children-adult discrepant pairs). Helmet use by adult bicyclists ranged from 49 percent in Baltimore County to 74 percent in Howard County

Table 1. Prevalence of helmet use among adult bicyclists by demographic and other characteristics, helmet observation study, Maryland, 1990–91<sup>1</sup>

Study characteristics	Howard County			Baltimore County			Montgomery County		
	Observed	Helmeted	Percent	Observed	Helmeted	Percent	Observed	Helmeted	Percent
<b>Survey dates:</b>									
July 1990.....	287	207	72	244	117	48	528	276	52
May 1991.....	262	200	76	321	160	50	426	212	50
<b>Sex:</b>									
Male .....	434	317	73	384	203	53	655	334	51
Female.....	115	90	78	181	74	41	299	154	52
<b>Ethnicity:<sup>2</sup></b>									
White .....	525	391	74	547	270	49	891	474	53
Other races.....	24	16	67	18	7	39	63	14	22
<b>Site:<sup>3</sup></b>									
School <sup>4</sup> .....	164	134	82	118	50	42	74	37	50
County roads .....	158	131	83	117	86	74	148	71	48
Residential streets.....	62	47	76	117	42	36	115	44	38
Parks, bicycle paths .....	165	95	58	213	99	46	617	336	54
<b>Census tract:<sup>2,5</sup></b>									
Middle class income.....	224	177	79	283	115	41	250	98	39
Upper middle class income ..	325	230	71	282	162	57	704	390	55
Totals .....	549	407	74	565	277	49	954	488	51

<sup>1</sup> July 1990 and May 1991 observations combined within each county unless indicated otherwise.

<sup>2</sup> Significant difference when all counties combined:  $P < .001$ .

<sup>3</sup> Significant difference between county roads and residential streets when all

counties combined:  $P < .001$ .

<sup>4</sup> Includes recreation centers and swimming pools.

<sup>5</sup> Middle = median household incomes from \$19,980 to \$24,170; upper middle = \$33,120 to \$72,260.

Table 2. Helmet use by solo bicyclists, Baltimore and Montgomery Counties, Maryland, helmet observation study, 1990–91

Age bracket	Males			Females			Total		
	Observed	Helmeted	Percent	Observed	Helmeted	Percent	Observed	Helmeted	Percent
Adult .....	549	295	54	157	70	45	706	365	52
Baltimore County.....	178	106	60	54	20	37	232	126	54
Montgomery County.....	371	189	51	103	50	49	474	239	50
Child.....	77	5	6	17	0	0	94	5	5
Baltimore County.....	25	0	0	1	0	0	26	0	0
Montgomery County.....	52	5	10	16	0	0	68	5	7

NOTE: July 1990 and May 1991 observations combined in each county.

(table 1). Within each county, the gender-specific use rates were similar for males and females. White adult bicyclists were more likely than those of other races to be observed wearing a helmet (58 percent versus 35 percent,  $P < .001$ ). Adult bicyclists were more likely to be observed wearing a helmet on county roads than on residential streets (68 percent versus 45 percent,  $P < .001$ ) and in upper middle class areas than in middle class areas (60 percent versus 52 percent,  $P < .001$ ).

Among the groups consisting solely of adults or children, or both, in Baltimore and Montgomery Counties, there were 800 solo, 359 pairs, 62 groups of three, 23 groups of four, 2 groups of five and 2 groups of six bicyclists observed. When the two counties were combined, 52 percent of solo adult bicyclists wore helmets compared with only 5

percent of solo child bicyclists ( $P < .001$ ); solo adult males were slightly more likely than solo adult females to wear helmets (54 percent versus 45 percent,  $P < .05$ ) (table 2). In Howard County, helmet use increased from 69 percent (101 of 147) during the baseline observations to 79 percent (114 of 144) during the followup observations among solo adult bicyclists ( $P < .05$ ) and from 3 percent (1 of 29) to 38 percent (9 of 24) among solo child bicyclists ( $P < .01$ ), as previously reported (12).

When the two counties were combined, there were 115 pairs (42 percent) of adults in which both members wore helmets, 127 pairs (46 percent) in which neither adult wore a helmet, and 35 pairs (13 percent) in which helmet use was discordant (table 3). For pairs of children observed, there was 1 pair (2 percent) in which both members wore helmets,

46 pairs (92 percent) in which neither child wore a helmet, and 3 pairs (6 percent) in which helmet use was discordant.

For pairs consisting of an adult and a child, there were 9 pairs (28 percent) in which both members wore helmets, 20 pairs (63 percent) in which neither member wore a helmet, 3 pairs (9 percent) in which the child was helmeted but not the adult, and no pairs in which the adult was helmeted but not the child (table 4). Concordant behavior was observed significantly more frequently than discordant behavior within adult-adult pairs ( $P < .001$ ), child-child pairs ( $P < .05$ ) and adult-child pairs ( $P < .01$ ) (table 4).

Among the 33 groups of three adult bicyclists observed in Baltimore and Montgomery Counties, all members wore helmets in 45 percent, no members wore helmets in 27 percent, and helmet use was discordant in 27 percent. The corresponding proportions were 0 percent, 100 percent, and 0 percent for the 14 groups of three child bicyclists and 33 percent, 47 percent, and 20 percent for the 15 groups of three persons that included both adults and children (table 4). The results were similar for groups of four bicyclists, although only 23 such groups were observed in the two counties (table 4). Concordance of helmet use was similar for male-male, female-female and male-female pairs of adults observed riding bicycles (table 3). The female was wearing the helmet in 14 of the 16 adult male-female discordant pairs and in both child male-female discordant pairs (table 3).

## Discussion

Bicycling appears to be especially popular among adults; despite our having selected observation sites with the intention of finding children riding bicycles, more than four times as many adults as children were observed. Helmet use by the adults observed in this study was substantially higher than among the children. Local bicycle touring clubs (whose members are primarily adults) have long urged their members to use helmets; some clubs have debated requiring bicyclists to wear a helmet when participating in club rides.

The study results may be compared with several prior reports. Based on roadside interviews with 516 bicyclists in Vermont, Wasserman reported helmet use rates of 4 percent for bicyclists ages 11–19, 8 percent for those ages 20–29, and 16 percent for those ages 30 years and older (11). In mailed surveys of bicycle club members, helmet use rates have been reported as 54 percent among 492

Table 3. Concordance and discordance of bicycle helmet use by group composition, Baltimore and Montgomery Counties, MD, helmet observation study, 1990–91

Group composition	Number of pairs observed			Percent concordant
	Both bicyclists helmeted	Neither bicyclist helmeted	Discordant use of helmets within pair	
Adults.....	115	127	35	87
Male-male.....	37	28	12	84
Female-female...	21	12	7	83
Male-female....	57	87	<sup>1</sup> 16	90
Children.....	1	46	3	94
Male-male.....	1	36	1	97
Female-female...	0	2	0	100
Male-female....	0	8	<sup>2</sup> 2	80

<sup>1</sup> In 14 of the 16 discordant pairs, only the female wore a helmet.

<sup>2</sup> In both discordant pairs, only the female wore a helmet.

NOTE: Data are based on July 1990 and May 1991 observations from Baltimore and Montgomery Counties combined.

Missouri bicyclists (9) and as 62 percent among 197 Australian bicyclists who had been involved in bicycle crashes (13). A helmet use rate of 57 percent was reported after a survey of 191 bicycling magazine readers who had struck their heads during bicycling mishaps (14). Helmet use rates of 70–90 percent were observed among adult bicyclists in Victoria, Australia, after the enactment of a mandatory helmet use law in 1990 (15).

In Howard County, we saw only weak evidence of a spillover effect on adults from the mandatory helmet law for children (12). Between baseline and followup observations, the helmet use rate changed from 72 percent to 76 percent for all adult bicyclists ( $P = .28$ ) and from 69 percent to 79 percent for solo adult bicyclists ( $P < .05$ ) in the county. It is not possible to determine whether the mandatory helmet law for children would have had a larger impact on adult use if baseline adult rates had been lower.

Of particular interest and unique to this study are the helmet use rates that are based on the age composition of the bicyclists within groups. Concordance of helmet use or nonuse was very high for all groups whether examined by age, county, sex, or group size. These data are consistent with the concept that both adults and children tend to adopt behaviors similar to their companions. From a public health point of view, one could predict that once a critical mass of bicyclists has been convinced to wear helmets, many (but not all) of their companions would also become helmet users.

DiGuseppi and coworkers (4) reported that children riding alone were five times more likely to wear a helmet than when riding with unhelmeted

Table 4. Concordance and discordance of helmet use by group composition among adults and children, Baltimore and Montgomery Counties, MD, helmet observation study, 1990-91

Group composition and size	Number of groups observed			Percent concordant
	All group members helmeted	No group members helmeted	Discordant use of helmets within group	
<i>Groups of 2<sup>1</sup></i>				
Adult-adult.....	115	127	35	87
Baltimore.....	45	55	12	89
Montgomery.....	70	72	23	86
Child-child.....	1	46	3	94
Baltimore.....	1	11	1	92
Montgomery.....	0	35	2	95
Adult-child.....	9	20	<sup>2</sup> 3	91
Baltimore.....	1	10	0	100
Montgomery.....	8	10	3	86
<i>Groups of 3<sup>3</sup></i>				
Adults only.....	15	9	9	73
Children only.....	0	14	0	100
Adults and children.....	5	7	3	80
<i>Groups of 4<sup>3</sup></i>				
Adults only.....	5	3	6	57
Children only.....	0	1	0	100
Adults and children.....	1	4	3	63

<sup>1</sup> July 1990 and May 1991 observations combined in each county.

<sup>2</sup> In all three pairs, the child wore a helmet and the adult did not.

<sup>3</sup> July 1990 and May 1991 observations and Baltimore and Montgomery Counties observations all combined.

child companions. Children riding with helmeted child companions were 22 times more likely to wear a helmet than when riding alone. Children riding with helmeted adults were 28 times more likely to be helmeted than when riding alone. Peer pressure has been identified in several studies as an important factor that affects a child's decision to wear or not wear a bicycle helmet (6,16). Our findings are consistent with the concept that peer pressure may also be a strong influence on helmet use by adults. The high concordance rate of helmet use among adult-child pairs highlights the importance of adults (especially parents) serving as role models in adopting behaviors to prevent injuries. In an observational study of child restraints in automobiles, Williams reported in 1976 that 22 percent of children were restrained in vehicles in which the driver was using a seatbelt, compared with only 2 percent of children when the driver was not using a seatbelt (17).

Several limitations should be considered when interpreting the results of this study. Observations of helmet use by recreational bicyclists were made on two Saturdays—one in May and one in July—at multiple suburban and rural sites in three Maryland counties. Such observations may not be representative of bicycle use during other days or months or

at other sites in Maryland. In particular, the data may not reflect the use of helmets by persons commuting to school or work on weekdays or by persons riding bicycles in inner city areas. Teenagers were excluded because too few were observed to permit meaningful analyses.

In addition, these data do not permit an explicit determination of factors such as location, trip length, or relationship to companions that lead a bicyclist to decide whether to wear a helmet on a particular day. Although it was possible to examine helmet use by pairs of bicyclists in certain combinations, too few pairs were observed to determine whether concordance of helmet use among adult-child pairs increased in Howard County after the helmet law went into effect. Finally, with ongoing helmet educational campaigns and the passage of a mandatory bicycle helmet law for children in Montgomery County in June 1991, the use of helmets in Maryland may be expected to change with time.

Several recent reports (7,18,19) indicate that education by physicians is relatively ineffective at influencing helmet use by children. Parents and teachers may be the most logical and effective providers of such education. Our results are consistent with the concept that both adults and children can serve as important role models in efforts to encourage all bicyclists to use helmets. Public health efforts focused on adults should strongly encourage helmet use by adults both to prevent head injuries to themselves and to provide an excellent role model for children.

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## Smoking Behavior of Adolescents Exposed to Cigarette Advertising

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### Synopsis .....

*The purpose of the study was to explore the relationship between the exposure of adolescents in the seventh and eighth grades to cigarette advertis-*

*ing and their being smokers. A survey questionnaire given to 602 adolescents assessed their exposure to cigarette advertising and provided measures of their smoking behavior, demographic characteristics, and some psychosocial variables.*

*The results indicated that exposure to cigarette advertising and having friends who smoked were predictive of current smoking status. Adolescents with high exposure to cigarette advertising were significantly more likely to be smokers, according to several measures of smoking behavior, than were those with low exposure to cigarette advertising. The findings extend previous research identifying factors that may play a role in the initiation and maintenance of smoking among adolescents.*

**C**IGARETTE SMOKING is the leading preventable cause of mortality and morbidity in the United States and has been described as the "most important public health issue of our time" (1). More than 40,000 studies have provided evidence on deleterious effects of cigarette smoking. A growing body of clinical and epidemiologic research demonstrates cigarette smoking to be associated with cancer, cardiovascular disease, and chronic obstructive lung disease (1-3). Cigarette smoking has been identified as the most widespread form of drug dependence in our society (2).

Cigarette smoking has declined in prevalence from more than 50 percent of the population during the late 1940s and early 1950s to about 25 percent (4). The reductions, in large measure, are the result of widespread public health campaigns on the national, State, and local levels by government and voluntary organizations. Other contributing factors have been legislative actions, such as banning cigarette advertising on electronic media, requiring warning labels on cigarette packages and cigarette printed advertising, and more recently, legislation restricting cigarette smoking in public